some one else has calibrated. Again, the determination of the mechanical equivalent of heat is a matter of vital importance to the engineer, but the best and most accurate work thus far upon the subject has been done by Prof. Rowland, a physicist, in his physical laboratory.

As a rule, when experiments are to be performed on the large scale they get beyond the possibilities of a physical laboratory. In this category we may place such experimental work as the testing of steam engines and steam boilers, the testing of the strength of materials of construction on a practical scale, &c.; but, in order to carry out these tests with proper accuracy, we have generally to perform delicate measurements, as, for instance, measurements of temperatures, &c., in the first, and measurements of very small elongations or shortenings in the second case, and consequently have to use the suitable apparatus with the necessary degree of accuracy.

Since we have just been considering mathematics and physics, which may be called general sciences, perhaps a few words should be said in regard to chemistry. I cannot claim for it a similar position of fundamental importance in the engineering part of an engineering course that belongs to mathematics and physics. Nevertheless, a certain amount of chemical knowledge is of great importance to all engineers; but when they have passed this point, although a farther knowledge would be useful, it is not one of the most important things. The chemical composition of fuels, of steels and irons, of cements, of oils, and of other materials, is a matter that directly concerns the engineer. It is true that he can usually have his chemical analyses made for him, and generally would better do so; but he must know enough of chemistry to understand the bearing which the chemical composition of his materials have on their use in engineering work. Some knowledge of industrial chemistry is also desirable, so that he shall understand the nature of the processes performed in manufactories in which chemical processes on a large scale are performed.

The instruction in chemistry should, if possible, be given very early in the student's course. In the case of the Massachusetts Institute of Technology, and also, I think, in that of several other schools, both lectures and laboratory work in chemistry are given in the first year, and when this is done the instruction in chemistry fulfils another important function, viz. it introduces the student at the very threshold of his course to a species of scientific work that obliges him to think, and this, in a direction in which, as a rule, he has not been trained in the preparatory schools. Especially is this true of the laboratory work, for, by observing the results of experiments which he himself makes, he must learn how to interpret the replies of nature; and as chemistry, unlike mathematics, is an experimental science, it trains the thinking powers of the student even more than do his algebra, geometry, and trigonometry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A PROSPECTUS of the course in practical chemistry at the Polytechnic Institute of Brooklyn has been received, and it indicates that very efficient work is carried on at the Polytechnic. The course, which is under the direction of Prof. P. T. Austen, appears to be adapted in every way to meet the wants of the day, and to train competent analytical and technical chemists. The claims of pure chemistry are also recognised, facilities being given for post-graduate work in it, as well as in applied chemistry and chemical engineering.

THE Department of Science and Art has issued the following lists of Scholarships and Exhibitions just awarded:—Whitworth Scholarships (tenable for three years), £125 a year each: Arthur H. Barker (24), engineer; George W. Shearer (21), apprentice engineer; Percy Nicholls (24), engineer; Harold R. Cullen (21), engineer. Whitworth Exhibitions (tenable for one year), £50 a year: Charles E. Goodyear (21), shipwright; George M. Brown (23), draughtsman; Norton Baron (22), engineering student; Harry Jackson (20), engineering student: Edward M. Leflufy (22), engine-fitter apprentice; Arthur E. Hyne (21), fitter apprentice; Robert McMillan (20), engineer apprentice; John W. Roebuck (23), fitter; George Follows (24), engineer; Arthur J. Baker (19), engine-fitter apprentice; William D. Ross (21), fitter; Frank H. Phillips (20), engineer apprentice; Henry T. Hildage (20), fitter; William P. Jones (25), marine engineer; John W. Milner (20), mechanical engineer; William Bayliss (20), apprentice fitter; John B. Shaw (21), engineer; James Walker (22), engineer; William H. C. Kemp (21), engineer apprentice; William J. Talbot (23), engineer; Henry C. Trigg (24), draughtsman; Duncan R. McLachlan (24), engineer; George A. Robertson (21), engineering student; Charles H. Imrie (22), engineer; William McG. Wallace (20), apprentice fitter; William J. Gow (20), apprentice fitter; William Lauder (20), draughtsman; Samuel A. Clarke (25), draughtsman; Edmund B. Ball (21), engineer student; Jabez W. Ashdown (20), engineer apprentice.

THE list of successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships (Science) is as follows:—National Scholarships for Mechanics: Edmund R. Verity (19), student; George Patchin (17), engineering student; Harry Jackson (20), engineering student; William Ditchburn, jun. (19), teacher. National Scholarships for Chemistry and Physics: Thomas S. Price (19), student; Franz E. Studt (21), tailor; Herbert Bailey (18), student; William Bennett (16), student; John W. Barker (18), laboratory assistant. National Scholarships for Biological Subjects: Thomas G. Hill (19), student; Ernest A. Scott (17), student. National Scholarships: Charles E. Goodyear (21), shipwright; Edward M. Leflufy (22), engine-fitter apprentice; William H. James (22), student; William T. Clough (18), student; Herbert Halliday (22), student; William Cameron (18), laboratory assistant; Ernest Hibbert (15), student; Sidney E. Lamb (21), engine-fitter apprentice; Joseph Lister (19), teacher; William Parker (19), student; Ernest T. Harrison (18), laboratory assistant. Royal Exhibitions: George E. Clarke (17), student; Edward C. Hugon (16), student; Thomas G. Procter (19), engine-fitter apprentice; John A. Tomkins (20), scientific instrument maker; William T. Swinger (20), engineer; John W. Roebuck (23), fitter; Robert L. Wills (21), shipwright apprentice. Free Studentships: William D. Ross (21), fitter; Leonard W. Cox (21), student; Edgar R. Sutcliffe (20), engineer; William P. Jones (25), marine engineer; Percy M. Hampshire (19), lecture assistant; William J. Talbot (23), engineer.

SCIENTIFIC SERIALS.

Bulletin de l'Académie des Sciences de St. Pétersbourg, 5th series, t. ii. No. 4, April 1895.—Proceedings, in which we notice the discovery, by G. Schneider, in Prof. Kovalevsky's laboratory, of lymphatic glands in the earth-worm, *Dendrolæna rubida* (Crimea), and in *Perichæta*; as well as a communication by E. Burinsky, on his method of restoring by means of photography the writing in old documents which time has rendered invisible. A number of good negatives having been taken on collodion pellicules, they are superposed, and the visibility of the faintest markings is rendered still greater by means of a "contrast positive" obtained with regulated artificial light.—Definitive researches into the variations of latitude at Pulkova, on the ground of older observations made with the great vertical circle, by A. Ivanoff (in French). The previous memoirs of the author on the same subject being considered as first approximations only, the definitive formulæ are now given. The observations of the years 1863–1875 and 1842–1849 are treated for that purpose separately. Both series lead to formulæ which agree very well with the formula given by Mr. Chandler in the *Astronomical Journal*, No. 322; however, the Pulkova observations of the first-named period seem to point to the necessity of slightly reducing the half-amplitude of the yearly term in Chandler's formula. Two long series of Pulkova observations thus fully confirm Mr. Chandler's conclusions.—On the measurements and calculations of some photographic charts of the stars, by F. Renz (in German). A catalogue of all stars, down to the magnitude 11·0, which were occultated by the moon during the last eclipse, was given in the *Astronomische Nachrichten*. It appeared, however, that occultations of stars down to the twelfth magnitude could be observed at several observatories. Accordingly, the corresponding region of the sky was photographed by Prof. Donner with such an exposure (25 minutes) as to obtain the stars of twelfth magnitude as well, and F. Renz measured their positions with the Pulkova Repsold apparatus. The Potsdam photographs of the same region, made in 1891, were also re-measured, while the right ascensions of thirty-five fundamental stars were accurately determined at Pulkova with the meridian circle. The agreement between the different plates is quite satisfactory; and no distortion of the field could be detected. However, there are certain small systematic errors which cannot yet be well

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explained. Thus, the right ascensions on plate i. are on the average by 0·047s. greater than the values deduced from plate ii.—The Arachnides collected by G. Potanin in Mongolia in 1876–1879, by E. Simon (in Latin). Part i. Aranæ and Opiliones; forty-one species are mentioned and described, nineteen being new species.—Do the spurs of the Carpathians penetrate into European Russia? by General A. Tillo (in Russian). The question is answered in the negative. Supan and Lehman, in Kirchhoff's "Länderkunde von Europa," trace the limits of the Carpathians outside the boundaries of Russia; so also the Russian geologists, Barbot-de-Marny and Karpinskiy, did not see continuations of these mountains either in Poland or in Russia. The new hypsometrical map, now compiled by the author on a larger scale (27 miles to the inch), confirms this view.—New or little known Ixodidæ in the museum of the St. Petersburg Academy, by A. Birula (in Latin). Eight new species are described and figured on two plates.

Memoirs (*Trudy*) *of the Kharkoff Society of Naturalists*, vol. xxvii., 1892–93.—Obituary of I. Th. Levakovsky, by A. Guroff, with a portrait.—Researches into the crystals of kermesite and uranotil, by P. P. Piatnitzky.—The Algue of the bays and peat-bogs of the Dnieper, in the government of Poltava, by M. Alexenko. This flora is poor, the *Cladophora*, *Confervæ*, *Enteromorpha*, and *Ulotrix* prevail, while Desmidiaceæ and Protococcoideæ are very rare; 371 species are mentioned.—The flora of the Central Caucasus, by I. Akinfieff, part i. (see Notes, vol. lii. p. 304).—On the part played by hydrocarbons in the inter-molecular respiration of higher plants, by W. Palladin. It had been shown by Diakonoff (*Ber. d. deut. bot. Ges.*, 1866) that certain fungi give up carbonic dioxide during their inter-molecular breathing, only when the surrounding feeding medium contains a substance capable of fermenting. It was desirable to verify whether the same is true with higher plants, but the difficulty was in the fact that the cellular sap always contains glucose, which itself is capable of fermenting. By a series of experiments on etiolated leaves, the author now confirms Diakonoff's conclusions for higher plants as well.—Short preliminary notes in the Addenda. Vol. xxviii., 1893–1894.—Geological description of Kharkoff town, with map and profiles, by P. Poustovitov.—On the part played by the secondary parallel chains in the grouping of forests and steppes in West Caucasus, by A. Krasnoff. An answer to G. Akinfieff's criticisms.—Materials for the Algæ flora of the government of Kharkoff, by M. Alexenko; 407 species are described.—Preliminary report on a geological excursion in the government of Kherson, by P. Piatnitzky.—Biological observations, by W. Taliev. A series of various observations of facts relative to the life of plants, which have hitherto attracted but little or no attention, chiefly relative to fertilisation, colouration, movements of plants, and heliotropism in connection with the affluence of sap.—On the flora of the basin of the Chakva, by A. Krasnoff, being a preliminary report of a botanic excursion into the province of Batum, containing an excellent general description of the vegetation, poor in species, but attaining a luxurious development of the individuals.—On the lichens of the neighbourhoods of Kharkov, by W. Tschernov; fifty-five species are described.—Chemical studies on the seeds of *Myristica fragrans*, by W. Palladin, being a note on a special substance which is found in several seeds, but neither in the leaves or in the twigs, and which is now studied in Prof. Schultze's laboratory at Zurich.—Preliminary report on botanical researches in the Verkhnednieprovsk district of Ekaterinoslav, by I. Akinfieff; twenty-six species, new for South Russia, have been discovered.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 12.—M. Marey in the chair.—Observations of planets made at Marseilles Observatory, by M. Coggia. The observations were made with the 0·26 m. equatorial, and for the planets BZ and CA (Charlois).—On algebraical surfaces which admit a continuous group of birational transformations, by M. Paul Painlevé.—On a special microscope for the observation of opaque bodies, by M. Ch. Fremont. The novelty in the microscope described, consists essentially in the method used for obtaining vertical illumination of the object, applicable with high powers. A concave mirror is arranged obliquely *inside* the microscope tube to reflect downwards a beam of light entering at a side aperture in the tube. The light passes through a prism which reduces the rays to parallelism with the axis of the microscope and then through the lenses of the objective to the object. The concave mirror and the prism are pierced centrally by a conical tube along which travel the rays of light from the object, the image being formed and magnified by the eye-piece in the usual way. M. Marey remarked on the great use the new modification would have in the chronophotographic study of the movement of microscopic beings.—On some melting and boiling points, by M. H. Le Chatelier. From the experiments made, it is probable that the melting point of gold determined by M. Violle to be 1045°, is a little low. The error is certainly not more than 20°, and the results so far obtained would not justify the alteration of the pyrometer scales in actual use.—On certain potassium derivatives of quinone and hydroquinone, by M. Ch. Astre. A number of potassium derivatives are described, concerning which it is stated: the action of metals on quinone, together with the existence of oxypotassium compounds yielded by quinone and hydroquinone (to be described in a coming paper) confirm the diketonic nature of quinone. The formation of these compounds and the passage of some of them from the hydroquinone to the quinone series, allow a formula to be given to quinone clearly expressing its diketonic character and accounting for its numerous reactions.—A theorem concerning the separation of the roots of numerical equations of every degree, by M. Teguor.—A white rainbow, by M. E. Kern. A lunar rainbow observed at 10 p.m. August 5.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

Books.—British Birds: W. H. Hudson (Longmans).—Lectures on Elementary Navigation: Rev. J. B. Harbord (Potter).—Polyphase Electric Currents and Alternate-Current Motors: Prof. S. P. Thompson (Spon).—Transactions of the Australasian Institute of Mining Engineers, Vol. 2 (Adelaide).

Pamphlet.—The Recent Evolution of Surgery: A. P. Gould (K. Paul).

Serials.—Journal of the Chemical Society, August (Gurney).—Proceedings of the Physical Society of London, August (Taylor).—Bulletin of the American Mathematical Society, July (New York, Macmillan).—Natural History of Plants: Kerner and Oliver, Part 15 (Blackie).—Bulletin de L'Académie Royale des Sciences, &c., de Belgique, 65e Annee, No. 6 (Bruxelles).—Astrophysical Journal, August (Chicago).—Royal Natural History, Part 22 (Warne).

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